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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Appellant: Liang et al.
Appl No.: 09/164,517
Filed: September 30, 1998
Title: Image Compression

Art Unit: 2623
Examiner: Wu
Docket: TI-26414AA

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APPELLANTS' BRIEF (in triplicate)

Assistant Commissioner
for Patents
Washington, DC 20231

MAILING CERTIFICATE	
I hereby certify that this correspondence is being deposited with the United States Postal Service as first class mail in an envelope addressed to: Assistant Commissioner for Patents, Washington, DC 20231 today.	
<i>Gracia Sansom</i>	<i>7-20-01</i>
Gracia Sansom	Date

Dear Sir:

The attached sheets contain the Rule 192(c) items of appellants' brief. The Commissioner is hereby authorized to charge the fee for filing a brief in support of the appeal plus an extension of time (separate petition enclosed) and any other fees to the deposit account of Texas Instruments Incorporated, account No. 20-0668; two additional copies of this first sheet of appellants' brief are enclosed.

Respectfully submitted,

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Rule 192(c)(1) Real party of interest

Texas Instruments Incorporated owns the application.

Rule 192(c)(2) Related appeals and interferences

There are no related dispositive appeals or interferences.

Rule 192(c)(3) Status of claims

Claims 1-7 are pending in the application with all claims finally rejected. This appeal involves claims 2-7.

Rule 192(c)(4) Status of amendments

There is no amendment after final rejection.

Rule 192(c)(5) Summary of the invention

The invention provides an image compression method with arithmetic coding of bitplanes and including differing contexts for differing portions of an image. Application page 12, last paragraph relates to claims 2-3, and application page 17, last paragraph to page 19, first paragraph relates to claims 6-7. Figs.2a-2c illustrate recursive wavelet transform and subband creation, and Figs.3a-3d show generation of the bitplanes from the wavelet coefficients.

Rule 192(c)(6) Issues

The issues presented on appeal are:

- (1) whether claims 4-5 are supported by the specification.
- (2) whether claim 2 is anticipated by the Chrysafis reference.
- (3) whether claims 3-5 are patentable over the Chrysafis reference.
- (4) whether claims 6-7 are patentable over the Chrysafis reference in view of the Tsai reference.

Rule 192(c)(7) Grouping of the claims

The claims are grouped as claim 2, claim 3, claims 4-5, claim 6, and claim 7.

Rule 192(c)(8) Argument

(1) Claims 4-5 were rejected as unsupported by the specification; the Examiner asserted that the specification does not clearly describe I, P, and B frames.

Appellants reply that paragraphs 2-3 on application page 2 describe the I, P, and B frames as those of the MPEG international standards, and this suffices for one of ordinary skill in the art.

(2) Claim 2 was rejected as anticipated by the Chrysafis reference. The Examiner asserted that the wavelet decomposition into subbands of Chrysafis is a decomposition into bitplanes and that the context model neighborhood of Chrysafis Fig.1 is the forgetting factor.

Appellants reply that wavelet subbands are not bitplanes and that the context model neighborhood of Chrysafis Fig.1 is not a forgetting factor. In particular, a wavelet transform produces a hierarchy of coefficients (illustrated in application Figures 1 and 2a-2c) and the terminology subbands refers to the components of the hierarchy levels (e.g., HH1, HL1, HH2, ...) and not bitplanes. That is, a subband is a set of wavelet coefficients, not just a bitplane of the wavelet coefficients. Application Figures 3a-3d show the recursive generation of the bitplanes for wavelet coefficients; and Chrysafis has no suggestion of bitplanes.

Further, Chrysafis Fig.1 and equation (2) define the predictor for a wavelet coefficient in terms of neighboring wavelet coefficients in a subband plus a coefficient from a prior subband; then the predictor's value is used to select a probability distribution to use for the coefficient (Chrysafis, page 243, last paragraph to page 244, second paragraph). In contrast, a forgetting factor as in claim 2 defines the size of the window (number of recent samples) used to estimate the probability distribution of the bits. Thus Chrysafis does not suggest the requirements of claim 2 (claim 1 dependent).

(3) Claims 3-5 were rejected as unpatentable over the Chrysafis reference; the Examiner asserted that the forgetting factor of claim 3 is a design choice and that the I, P, and B frames are well known.

For claim 3 (claim 2 dependent) appellants reply that the particular forgetting factor of claim 3 is not a design choice for Chrysafis because Chrysafis equation (2) is not an estimation of a probability distribution but rather a predictor which determines the selection of a probability distribution; see page 243, last paragraph.

For claims 4-5 (claim 1 dependent) appellants reply that Chrysafis does not suggest the use of the single image encoding with an arithmetic coder as part of an MPEG-like video encoding where the I frames are separately encoded and the P and B frames predictively encoded.

(4) Claims 6-7 were rejected as unpatentable over the Chrysafis reference in view of the Tsai reference. The Examiner asserted that using the run-level contexts of Tsai corresponds to simple and natural image portions of the claims and would be obvious to combine with Chrysafis.

Appellants reply that the two contexts of Tsai derive from the run length coding of the quantized transform coefficients and the two contexts do not relate to portions of an image. In particular, run length coding of a sequence of numbers codes the 0's differently from the other numbers; this is useful in coding sequences which may have many 0's. For example, Fourier transform coefficients for blocks of pixels in an image often have many high spatial frequency coefficients equal to 0 after quantization; this corresponds to a lack of sharp edges in the block of pixels. Similarly for DCT and wavelet transform coefficients, and Tsai is coding such transform coefficients. Run length coding encodes 0's by how many 0's appear in succession (the "run length") in the sequence being coded, and non-zero numbers are coded according to their levels (values); see Tsai Figs. 4A-4E. Tsai notes the differing statistics of the 0 run-lengths and the levels, and consequently Tsai uses a separate context for each in the arithmetic coder. This has no suggestion of claim 6 (claim 1 dependent) that the image be separated into simple and natural portions for coding.

Further, claim 7 (claim 6 dependent) requires the wavelet transform only be for the natural image portions and the simple image portions use the un-transformed pixel values. In contrast Tsai run-length codes and uses two contexts for a single integer list derived from a transform; see Fig.1. Consequently, Tsai has no suggestion of the image partition of claim 7 with differing transform treatments, and Tsai combined with Chrysafis yields confusion. Indeed, the run-length coding of Tsai destroys the Fig.1 coefficient predictor of Chrysafis.

Rule 192(c)(9) Appendix

1. A method of encoding an image, comprising the steps of:
 - (a) decomposing an image into bitplanes; and
 - (b) arithmetic encoding the bitplanes with a context model from the neighboring bits in a bitplane and previous bits at the location in previous bitplanes.
2. The method of claim 1, wherein the decomposition of the image into bitplanes includes:
 - (a) wavelet transform the image into a hierarchy of coefficients and the bitplanes are of transform coefficients; and
 - (b) the arithmetic coding includes a forgetting factor for the adaptive context statistics determination.
3. The method of claim 2, wherein the context model forgetting factor is 127.
4. The method of claim 1, wherein:
 - (a) said image is an I frame in a video sequence of frames including I and P frames in which P frames use motion compensation.
5. The method of claim 4, wherein:
 - (a) said video sequence also includes B frames which use bidirectional motion compensation.
6. The method of claim 1, wherein
 - (a) the decomposition of the image into bitplanes includes a partition of the image into simple and natural image portions; and
 - (b) the arithmetic coding uses different context models for the simple and natural image portions.

7. The method of claim 6, wherein:

- (a) in the simple image portions the bitplanes are of the [sic] pixel values; and
- (b) in the natural image portions the bitplanes are of wavelet transform coefficients.